

THE HISTORY AND DEVELOPMENT OF STREET LIGHTING IN WASHINGTON

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by

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## S U M M A R Y

The evolution of street lighting in Washington has been like that of many other cities of its type. The three principle systems of lighting in their order of installation were; oil, gas, and electric.

The first stage, oil street lighting, was in use during the first fifty years of the nineteenth century. As soon as gas was developed to the point where it could be manufactured commercially, the gas street lights superseded the oil lamps.

Gas street lighting lasted throughout the nineteenth century and through the first thirty years of twentieth century. The types of lamps used were the flat-flame and then the incandescent mantle lamp. It is recognized that the exit of gas street lighting was far overdue and this can be attributed to difficulty of obtaining funds from Congress for such changes. This period also saw the rebirth of the oil lamp due to the slow expansion of gas and electric street lighting.

Although electric street lighting appeared in 1885, it did not come into general use until the development of the tungsten incandescent lamp. The arc lamps was the first type used there being the open, enclosed, and magnetite arcs, the last being still in use. Also some twenty-five cp carbon filament lamps were in use at the end of the nineteenth century.

The march of street lighting progress has been up until the present time in a foward direct line. The depression has caused Congress to cut the District appropriation, thus removing from service 1,281 lamps and reducing the candle power of 4,610 lamps. It is to be hoped that this move is only temporary and the street lighting division will recieve sufficient funds to continue its good work.



## THE HISTORY AND DEVELOPMENT OF STREET LIGHTING IN WASHINGTON

At first, streets were lighted for our personal satisfaction in being able to go about at night with a minimum of inconvenience. We must recognize that it is indeed a great luxury now to be out at night when we stop and think what a hardship it must have been in the days of our forefathers to use a pine torch, later a candle or finally a lantern, in order to go from one place to another after dark. Now, however, streets are lighted not merely for our personal convenience but to reduce crime, to reduce accidents, to speed up traffic, to increase civic pride, to stimulate business and other activities and thereby boom or exploit the city itself.

When streets are properly lighted, crime is reduced to a minimum which in itself is of paramount importance to both the city and the individual. The better the street lighting, not only on busy thoroughfares, but also on alleys, side streets, etc., the harder it will be for crime to be committed and the criminal to escape under cover of darkness.

Accidents can be greatly reduced by intelligent, proper and adequate street lighting and at the same time traffic may be speeded up with a degree of safety comparable to that attained by daylight. Traffic conditions today are entirely different from what they were a decade ago--the automobile was then just becoming a necessity--today there are so many of them that they constitute a menace to life and limb. This menace has been met to some extent by day but little has been done to combat it at night. Furthermore, the requirements of traffic are increasing continuously. It has been conservatively estimated that, for every dollar per capita per year spent for additional street lighting, there would be three dollars per capita saved due to fewer accidents, lawsuits, doctors' and hospital bills, etc.

The psychological aspects of street lighting are emphasized by the necessity of lighting the surroundings as well as the street surface itself.



This is particularly true with the many public monuments and buildings of Washington, the beauty of which should be conserved at night through proper lighting. It is not to be expected that night illumination can quite equal day illumination, either in respect to intensity or direction of light, but it is possible to produce artificial quality and quantity of light the latter being purely a function of expense. Desirable results can be obtained by using large units of not too great brilliancy placed attractively in the field of vision, as with the Capitol and Washington Monument, producing pleasant changes in direction of the shadows on the buildings, thereby helping vision and bringing out the architectural beauty.

Street lighting likewise is responsible for bringing about civic betterment, civic pride and civic expansion. In many cases insufficient illumination has delayed the progress of cities or towns and often a slight improvement in illumination has resulted in considerable progress.

Street lighting had its beginning in Washington at the start of the nineteenth century. On January 12, 1803 an ordinance was passed by the city council directing the Mayor "to cause lamps to be placed on the most public avenues and streets, to supply them with oil, and to employ persons to attend to lighting them and keeping them in order". These oil lamps were burned throughout every night during the year until 1830 when for the sake of economy the lamps were only lighted from the first day of December to the 30th day of April. This act marked the beginning of Washington's "moonlight" system which continued until the end of the nineteenth century.

It was only natural in the fifties that gas street lighting should replace oil. The first attempt at gas illumination was made in 1846 when lamps burning Crutchett's Solar Gas, which was produced from oil, were placed on Capitol Hill and North Capitol Street. These lamps gave a very satisfactory and brilliant light but since it was impossible to manufacture this gas at a profit the experiment failed. Developments in gas manufacturing made



it possible to operate this type of lamp at a lower cost than the oil lamp. On June 3, 1853 an ordinance was passed directing the Mayor "to erect gas lamp posts upon the application of the owners of more than half the property in any portion of a street not less than a square, the cost to be borne by the property fronting on that portion of the street". The gas lamp replaced the oil lamp quickly until 1875 when only gas was used. At this time there were 3,561 flat-flame gas lamps in use, each which burned 2200 hours and 10 minutes a year.

The first attempt at electric lighting was made in the fall of 1881 at the dedication of the statue to General Thomas in Thomas Circle. It was planned to use arc lamps supplied with current from a generator in a sawmill. Due to defects in the wiring system used this attempt failed. The result of this experiment was the incorporation of the Heisler Electric Light Company with a small experimental plant in the Washington Post Building supplying current to a small number of lights in the neighborhood of Pennsylvania Avenue and 10th street. In 1882 this company was taken over by the United States Electric Light Company which at the end of its first year of operation had in use 90 arc and 100 incandescent lamps. The company then proceeded to increase its equipment and reach out for business. It had plenty of money available but no business as there was popular timidity as to electric current and strong opposition from organizations interested in gas. This company was intent on using modern devices and methods and in 1884 laid an underground conduit on Pennsylvania Avenue and other streets being one of the pioneers of underground conduit construction in which its expensive system was regarded as a model. During the first two years of its life the lights were only on Pennsylvania Avenue and these at the company's expense. Later lights were placed on F street when a number of property holders and merchants decided to obtain arc lamps for which they subscribed a sum of money and thus gave their street an unassailable business supremacy which has continued to the present



day.

Until 1884, all electric street lighting had been carried on by private interests at their own expense. On August 15, 1884, the District Government entered into a contract with the Brush Swan Electric Company for the lighting of Pennsylvania Avenue from the Capitol to the Treasury, and all streets radiating from the Capitol for 5000 yards. Experiments were made with 2000 candle power arc lamps, using different types of reflectors, placed on the dome of the Capitol and also the roof of the Treasury. This was found to be unsatisfactory and dangerous owing to the light being high and concentrated causing persons driving on the street to become confused and blinded. Also, in places where there were trees the light was unable to penetrate the dense foliage thus leaving the sidewalks perfectly dark. These lamps replaced 278 gas lamps, but on October 1, 1884 were abandoned and the gas lamps relighted. The Brush Swan Company was bought in 1885 by the United States Electric Light Company when the latter's plant was destroyed by fire. On January 1, 1885 the District Government contracted with the United States Electric Light Company for lighting of F Street, North West from ninth to Fourteenth Streets with fifteen arc lamps on iron posts with underground wires, to replace twenty gas lamps. This provided very satisfactory lighting except that in many places the foliage was so dense so as to impair the distribution of the light.

The type of lamp used at this time was the open arc consisting of two carbon electrodes exposed to the air. A gravity feed was used and the up motion of the positive electrode was obtained by means of a solenoid. The positive carbon had a life of only ten hours which meant that it required as much attention as a gas lamp. Due to the crater formed on the positive carbon, light from the lamp was concentrated and poor distribution resulted. Later this type lamp was replaced by the closed arc lamp. The carbons in this lamp were enclosed from air by a separate covering, giving the carbon longer life.



This was about 100 hours which was an improvement over the open type. The carbons also burned with parallel faces thus allowing a 180 degrees distribution which made up for the reduction in their candle power to 1000.

During the year of 1888, the number of arc lamps increased to 105, burning 4,289 hours from sunset to sunrise against 2600 hours for the gas lamps. The Superintendent of Lamps in this year requested that the gas lamps be burned for 3200 hours a year and that money be appropriated for the trimming of trees. Washington, at this time, was the only city of its size on a moonlight schedule, the gas lamps being dark during a part of the summer. It was necessary to have the year around lighting because of storms in the summer, darkness caused by shadows of tall buildings, and the increasing denseness of the foliage of trees.

The year 1888 also saw the rebirth of the kerosene oil lamp. This was used in many alleys and suburban localities where gas mains had not yet been laid or the cost of electric lighting was too high, but where street lighting was necessary. It was also suggested that the sixteen candle power gas lamps be replaced with forty or fifty candle power incandescent electric lamps.

In 1892 there were in use 5,496 gas, 539 oil, and 324 arc lamps. Two years later a change was made from kerosene oil to naphtha in the oil lamps. In 1896, the first District paid for incandescent lamps appeared. These were the carbon filament type and seventy were put into use. This year also saw the incorporation of the Potomac Electric Power Company. The next year marked the beginning of the present day system with the abandonment of the moonlight schedule for an all-night every-night schedule, the lamps being lighted forty-five minutes before sunset and turned off forty-five minutes after sunrise.

The Electrical Department of the District of Columbia was established in 1898 having charge of lighting the streets. All the work in connection with street lighting was done by private corporations operating under annual contract with the District. Materials and labor were supplied by them at a



flat rate per annum for each lamp maintained. The character of service given was checked by the department inspectors. All changes and extensions were and still are ordered through this department and the work done by the private corporations. The consolidation of the Potomac Electric Power Company with the United States Electric Light Company in 1902, left only the former in the electric field in Washington.

In 1904, the oil lamps were changed from the old style flat-flame Wellington burner to the Welsback incandescent mantle. The cost and number of lamps used in this year is listed as follows:

6700 flat-flame gas at \$20 per year.

950 Welsback gas at \$21 per year.

1400 Welsback naphtha at \$22.60 per year.

900 incandescent 25 candle power electric at \$20 per year.

990 enclosed arc at \$85 per year.

The incandescent lamps were used principally in the suburban districts where overhead wiring was not objectionable, they being connected in multiple. The arc lamps were all connected on underground circuits, 380 of the low tension enclosed type being operated in multiple on the Edison three wire system in the heart of Washington's business section. The other 610 were of the series enclosed type.

The magnetite arc lamp was introduced to Washington in 1907. This lamp had as its positive electrode a block of copper of 4,000 hours of life and a bar of magnetite of 1,000 hours life as the negative electrode. Its longer life brought its maintenance cost below that of the enclosed arc and it is only natural that it was substituted for the latter. This year also saw change from the flat-flame gas lamp to the mantle gas leaving only 31 of the latter in service. At this date there were 12,944 lamps of all kinds in service.

The next year the present incandescent system started. Until this time only 25 candle power carbon filament incandescent multiple lamps had been



used. To these were added the following:

40 cp metalized filament.

40 cp tungsten.

50-75-100 cp metalized filament,

Also, in this year a new <sup>electric</sup> ~~gas~~ lamp, the four glower Nernst lamp was introduced.

In 1909 extensive tests were made on all types of lamps in use. The result of these tests clearly showed the superiority of the incandescent lamp over the arc lamp. For small distances from the lamp the latter gave more light but after a certain distance the incandescent lamp provided more and better light. Also arc lamps were spaced far apart due to their high candle power and the failure of one threw a large area into darkness while the reverse was true of the incandescent lamp. The tests also sounded the death knell of the four glower Nernst lamp whose operation and maintenance had proved unsatisfactory. Two new types of lamps were added, the seventy-five cp tungsten incandescent and an alternating current enclosed magnetite arc.

The naphtha lamps were taken out of service in 1912. These lamps had been regarded as a fill-in and their replacement was recognized as long overdue. Forty cp gas and incandescent lamps were put in their place. The costs of the lamps were \$22.80, for the oil, \$18.40 for the gas, and \$15, for the incandescent. The superiority of the electric lamp over gas as regards to light was recognized before this, but now it can be seen that the former cost less. The next year an act was passed requiring all enclosed arc lamps be changed to magnetite arcs, this being completed in 1916. The lamps in use this year were as follows:

Gas mantle-10,248.

Arc

6.6 ampere magnetite-317

4.0 ampere magnetite-523

Electric incandescent



Electric incandescent (cont.)

250 cp series-4

100 cp series-3,428

100 cp multiple-98

60 cp series-3,323

60 cp multiple-321

Four glower Nernst-64

Street designation-479

Total-18,805

The Nernst lamps were all replaced in 1919 with 100 cp incandescent multiple electric lamps.

The 600 and 400 cp series incandescent lamps were added in 1923. Three years later gas street lighting reached its peak with 12,065 gas lamps in use. In this year only a few four ampere magnetite lamps were left due to the desire to unify the system at 6.6 amperes. From this year the gas lamps decreased in number. This step was reconized as long overdue, for the electric lamp had far out matched the gas lamp in both power and efficiency. The gas lamps in use were of the 60 cp single burner and 120 cp double burner.

At the present time there is in use, 53 gas lamps which are being taken out of service as soon as they fail. There is also 28,701 incandescent lamps and 846 arc. The arc lamps are being replaced by 1000 cp incandescent lamps, as it is desired to eliminate direct current from the system, this being supplied by mercury arc rectifiers in the substations.

The planning of a city's street lighting system is recognized today to be a far more complex and difficult proposition than it was considered a few years ago. Street lighting expertness can only be acquired after long experience and intimate acquaintance with the various factors as engineering, physiological, psychological, economic, etc., entering into the problem, because engineering factors, such as foot-candle intensities, photometric data,



etc., are among the least of our considerations. This is evident, if it is to be remembered that the success of the results obtained must be measured by the degree of satisfaction given to the eye. This fact also explains why the standards of street lighting are continually changing. What was considered good lighting yesterday, is discarded today for higher intensities, more pleasing distribution of light, or both. Not only are our standards getting more exacting day by day but the conditions to be met are changing continually.





Flat-Flame Gas Lamp





9.6 ampere Open Arc Lamp





9.6 ampere Open Arc Lamp





60 cp Welsback Gas Lamp





Series Enclosed Arc Lamp





6.6 ampere Enclosed Arc Lamp



Multiple Circuit Enclosed Arc Lamp





6.6 ampere Magnetite arc Lamp



616 ampere Magnetite Arc Lamp





6.6 ampere Magnetite Arc Lamp

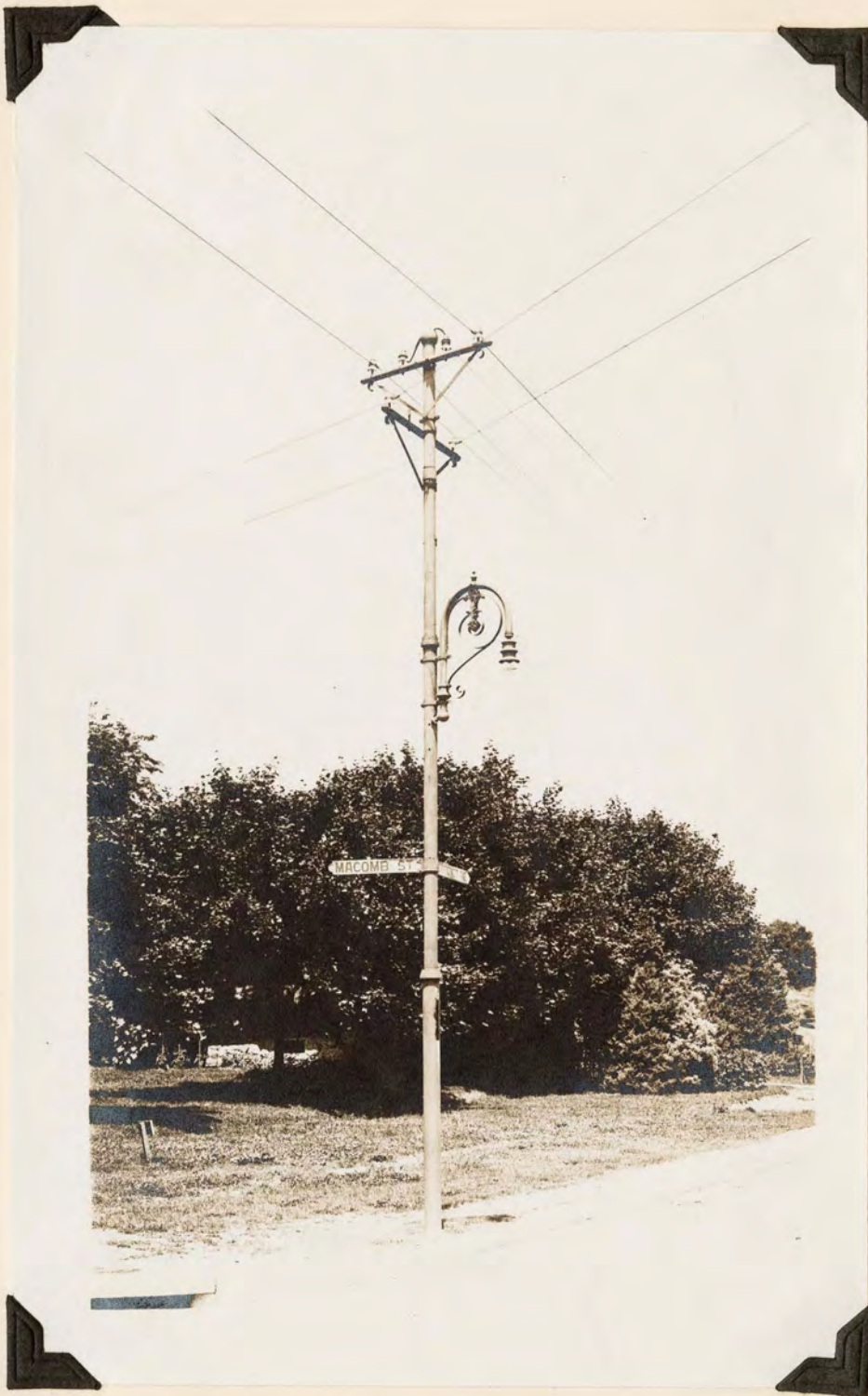


Electric Fire Alarm Lamp-twenty-four hours service.





Series Incandescent Electric Lamp



100 cp Incandescent Electric Lamp with Radial Wave Reflector  
used for Suburban Lighting



## B I B L I O G R A P H Y

1. Mr. Patterson- Street Lighting Engineer, Potomac  
Electric Power Company.
2. Mr. Allen- Washington Gas Light Company.
3. Reports of Commissioners of The District of Columbia.
4. History of the City of Washington by William Tindall.
5. Photographs by courtesy of Street Lighting Division of  
the Electrical Department.